

# Elementary Teachers' Use of Mathematical Textbooks in Korea

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## **Abstract**

The purpose of this research is to analyze Korean teacher textbook use and explore the effective use of textbooks. The researcher surveyed teachers to obtain information relative to their dispositions and views of textbook use, and a subset interviewed to obtain additional insight about these views. For the sample, 278 elementary school teachers were surveyed and a group interview was conducted with 6 teachers. The results showed that many teachers teach all the students simply by following the textbook content. These results suggest that for effective use of textbooks, teachers need to understand how to reconstruct the textbook within an understanding of the textbook authors' intention for the textbook content.

## **I. Introduction**

A textbook has value as an effective way for directing the educational goals. A textbook is a learning resource to help students engage in learning activities rather than simply introducing the subject knowledge. Also, the textbook influences what happens in the classroom learning.

Especially in mathematics, as the fundamental resource for lessons, the textbook is always used to identify the educational objectives and regulate the content and boundaries of the learning experiences. Thus, mathematics textbook plays an important role in teachers' and students' teaching and learning processes.

With the role and importance of the textbook in Korean education, whenever curriculum reform happens the basic content and criteria of the textbook become even more essential. The basic guidance of the textbook for enhancing students' learning abilities and developing creativities with the reform curriculum in 2007 include:

1. The textbooks must faithfully reflect the curriculum.
2. Appropriate textbooks for the curriculum are centered within the school education system.
3. Learner-centered variety and high quality textbooks are provided. (Ministry of Education Science and Technology, 2007).

With this basic guidance and Korea's continuing endeavor for making good textbooks, the textbooks have been developed with high quality. However, making good textbooks does not necessarily lead to effective use in the classroom teaching.

While some teachers use lessons directly from the textbook and its organization, others use textbooks as a resource when considering and selecting context and determining the content order through their own reasons. Some teachers never use the textbooks for their lessons. Since the teacher and textbooks are two important elements in implementing a particular curriculum (Fanzhe & Ningzhong, 2009), analyzing how teachers use the textbooks can serve as important indicators for judging how the intended curriculum is implemented. Limited research exists on how teachers use textbooks, especially in the use of mathematics textbooks. Accordingly, it is meaningful to investigate the teachers' use of textbooks in their classroom teaching and discuss methods for effective textbook use.

Kim and Pyung (2004) investigated elementary teachers use of elementary mathematics teacher manual on seventh and sixth reformed curriculum, making comparisons of their use. From their results, they discussed the problems on elementary mathematical textbooks in using the 7th reformed curriculum. However, there is a limitation on discussing the problem of using mathematical textbooks only in terms of use of the teacher's manual. Son and Choi (2008) investigated how elementary teachers used mathematical textbooks and the variables that influenced their use. Through their research however, the researchers classified the types of the teachers' textbook use only in terms of how the cognitive aspect of the mathematics problems in the textbooks appeared in classroom teaching. The researchers needed evidence of the effective use of the textbook in their investigation – the teachers' awareness of use of the textbooks with a more comprehensive view, and how teachers used the textbooks in the classroom teaching in general without any limitations from specific units or problems.

This research investigated elementary teachers' awareness of mathematical textbooks and their use. The researcher interviewed teachers who used the textbook effectively in order to obtain specific and practical information. The results of the study provide the fundamental data sources for searching the effective use of textbooks on the intentional curriculum implementation in the classroom teaching. The research questions were:

1. What is the elementary teacher's awareness of mathematics textbook in Korea?
2. How do elementary teachers use the mathematics textbook in Korea?
3. What are specific, effective uses of the mathematics textbook by elementary teachers in Korea?

In this research, mathematical textbooks include the mathematics textbook and the mathematics workbook as provided in Korea.

## **II. Theoretical Background**

### **1. A point of view about textbooks**

A point of view about textbooks includes one’s awareness about the property of textbooks and the position and role of textbooks in teaching. First, we have two points of view about textbooks based on open and closed perspectives. Thinking a textbook is the only learning resource like the Bible is the closed perspective. The open perspective is that a textbook is one of the various resources and if there is better content than in the textbook, one should accept the content even if that content is not in the textbook. Thus, in the closed perspective a textbook content has no error and maintains absolute authority. However, in the open perspective textbook content is relative and there are more text tools (Ministry of Education Science and Technology, 2000). In Korea, the closed perspective was more dominant in the past but recently an open perspective is becoming more dominant. In other words, the textbook is not the only resource but a tool for assisting students' learning and a referent resource. The open perspective is the focus of this research.

Also, we can have two points of view based on the criteria of whether the textbook supports teachers' profession or constrains it. First, educators who see textbooks as a mean for instructional improvement emphasize textbooks as a supplemental resource for teachers' lack of knowledge and experience, and regard textbooks as an important method for realizing educational reform. Also, they hypothesize that teachers will follow the textbook if they supply well-developed new textbooks, and as a result students' achievement will be improved. In the contrast, the educators who think that the textbook constrains the teacher's professional teaching activities insists that the textbook simplifies the teacher's professional teaching role, constrains teacher's decision making, and restricts students' learning chances (Son & Choi, 2008). Teachers have to decide the content and teaching methods for each lesson. However, if we consider that they don't have much time to prepare the lessons, differing from the later point of view, this research supports the point of view that the textbook is necessary for classroom teaching as an element for decision making. If the textbook is a necessary resource for teaching activities in the classroom, we should make good textbooks first and guide teachers not to simply follow the given textbook but to use them effectively.

## 2. Korean curriculum and textbooks

### A. The fundamental direction of making Mathematical textbooks

For the 2007 Korean educational reform, making good quality textbooks is a goal for accomplishing a desirable human character and educational goals. The fundamental direction for textbooks is ‘making the textbooks for the improvement of students' learning abilities and creativity.’ The specific components are below <Table 1> (Ministry of education science and technology, 2007).

<Table 1> The fundamental direction for making Mathematical textbooks

Fundamental Direction	Contents
Make textbooks for substantially reflecting curriculum	Reflects desired human images.
	Reflects each subject curriculum
Make textbooks for changing	Make the textbooks as a main educational resources for the curriculum

curriculum-centered school education	Make teaching and learning process-centered
	Make classroom friendly textbooks that teachers can use
Make student-centered high quality textbooks	Construct the content for improving thinking skills, inquiry, and creativity
	Material which can be easily understood, enjoyably and useful

**B. Fundamental direction and system of structure for making mathematical textbooks**

Elementary mathematics textbooks and workbooks follow the fundamental direction mentioned above. In particular, they emphasize the self-directed learning goal of considering students' levels, students' reasoning, communication, and problem solving abilities, and positive attitude toward mathematics. In addition, the mathematics textbook emphasizes everyday life phenomenon or familiar situations for students. Also the mathematics workbook emphasized the suitable use of knowledge and skill acquired from the mathematics textbook and reinforced the ability to teach and learn based on students' abilities and levels.

If we consider the structural system for units in mathematical textbooks, the number of units is composed of 8 units. The mathematics textbook is organized by the order of 'unit-cover, learning contents for each lesson, solve problems for unit assessment, and inquiry activity'. The mathematics workbook is made by the order of 'unit-cover, preparation for learning, learning contents for each lesson, problem solving, story-yard, and play-yard.' Each structural element's manuals are <Table 2> and <Table 3>.

<Table 2> The direction and structural system for making mathematics textbook

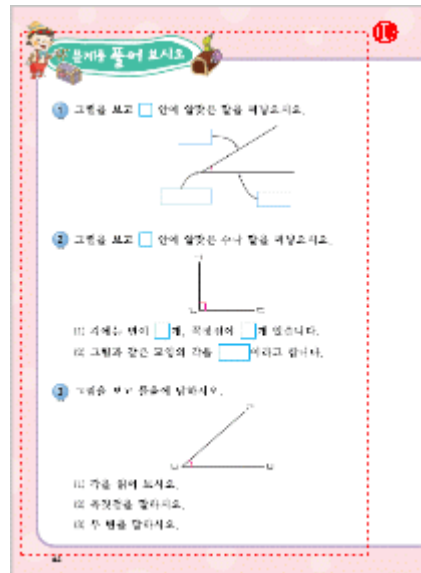
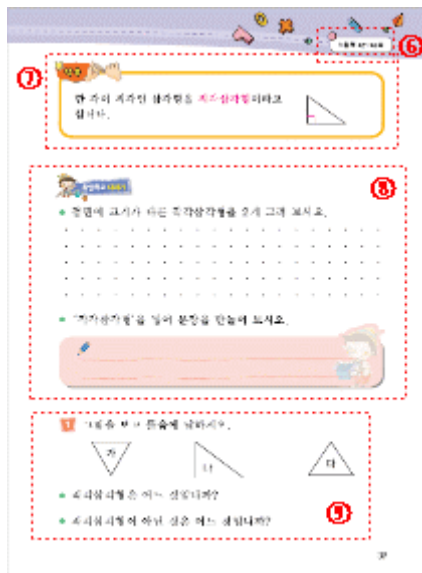
The direction of making mathematics textbooks	<ul style="list-style-type: none"> <li>▪The textbook reflects curriculum</li> <li>▪Enjoyable textbook with everyday life phenomenon or familiar situations for students</li> <li>▪The textbook considers student developmental level with easy to understand contents and appropriate for self-directed learning</li> <li>▪The textbook promotes development of mathematical reasoning ability, communication skills, and problem solving ability</li> <li>▪The textbook assists students' understanding of the worth of mathematics and promotes positive attitudes toward mathematics</li> <li>▪The textbook for is designed with learning tools using proper edition and adjusted for level based learning</li> </ul>
The constructional system of textbook unit	
Content by unit	example) 3rd grade first semester Unit 3. Plane Figure



- ① Unit name
- ② Symbolic illustration for the unit content



- ③ Learning theme: described from student's side
- ④ Open mind: showing right situation for Learning theme, think about the situation and discuss about what they think
- ⑤ Activity: to realize the learning theme, operational, intuitive and abstract activities are showed and discussed about each case

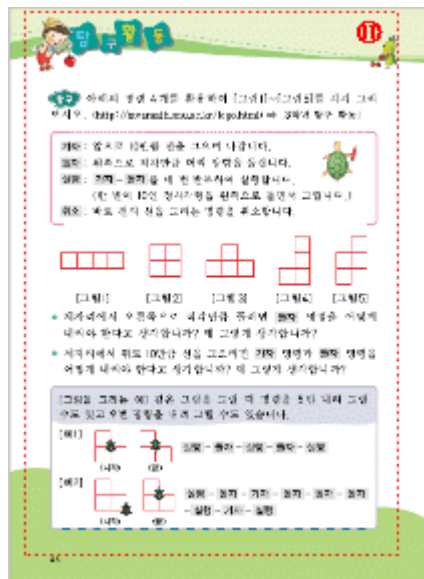


⑥ The page number related with mathematics workbook

⑦ Define: mathematically define the learning content through the open mind or activities

⑧ Check and confirm: to check and confirm whether the mathematical concepts are well developed, students make a picture or make a sentence with defined sign and vocabulary

⑨ Practice: problems and exercises to practice all learned content



⑩ Inquiry activity: Introduce the methods which is different from the learning content in a unit

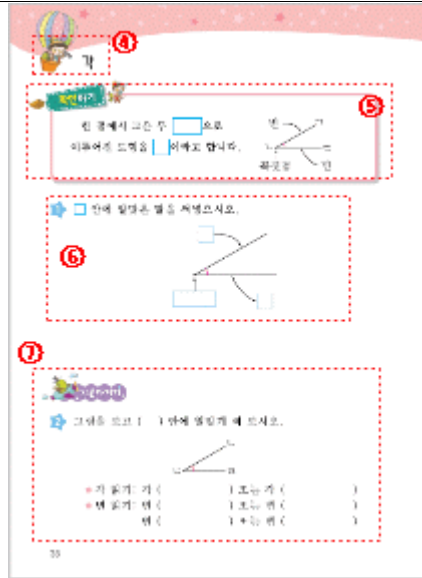
⑩ Solve problems: assess the learning content of a unit showing problems reflected the each lesson content



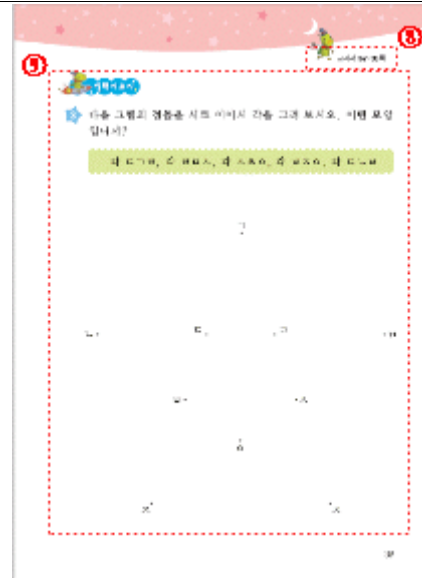
⑩ Materials: the necessary materials for learning are added on the appendix with page number in mathematics textbook

<Table 3> The direction and structural system for making mathematics Workbooks

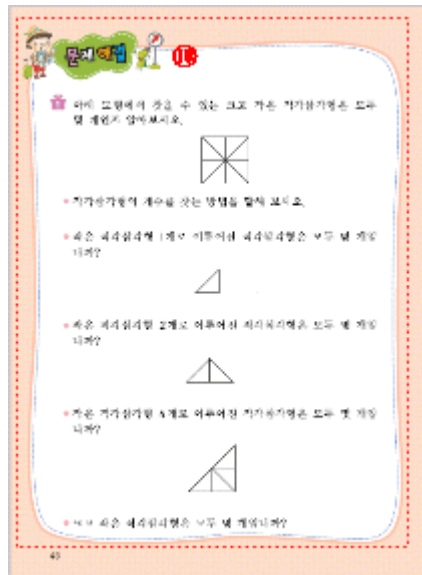
	<ul style="list-style-type: none"> <li>▪The workbook reflects the curriculum well</li> <li>▪The workbook reinforces the knowledge and skills learned through textbook</li> <li>▪The workbook considers student developmental level with easily understood contents and supports self-directed learning</li> <li>▪The workbook facilitates teaching and learning based on students' abilities and levels</li> <li>▪The workbook develops mathematical reasoning ability, communication skills, and problem solving ability</li> <li>▪The workbook promotes students understanding the worth of mathematics and promotes positive attitudes toward mathematics</li> <li>▪The workbook develops learning effects using proper edition and designing level based learning</li> </ul>
<p>The constructional system of workbook units</p>	
<p>Content by unit</p>	<p>example) 3rd grade first semester Unit 3. Plane Figure</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>① The unit name</p> </div> <div style="text-align: center;"> <p>② The illustration for introducing the unit: Symbolic cartoon for the unit content</p> </div> <div style="text-align: center;"> <p>③ Each unit 'preparation for learning' provides about 2 pages to check the prior knowledge necessary for learning the unit</p> </div> </div>



- ④ Learning theme: same as textbook and described from student's sides
- ⑤ Checking: content from textbook is organized and summarized
- ⑥ Basic problems: very basic problems which can be solved intuitively
- ⑦ Confirm the basic: the problems include basic process



- ⑧ The page number related with the mathematics textbook
- ⑨ Cultivate ability: the problems correspond to more difficult levels

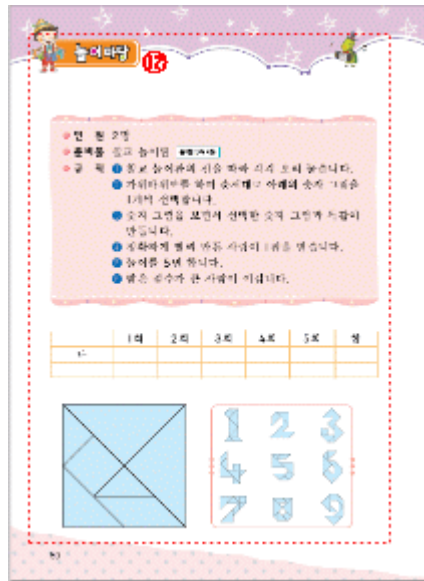


- ⑩ Problem solving: problems are given in each unit to develop problem solving ability

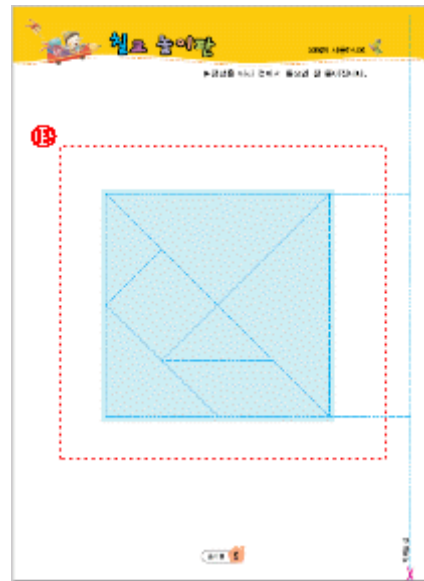


- ⑪ Story yard: history of mathematics or similar story which is adjusted to the unit content and can motivate students' interest about mathematics





⑫ Play yard: to raise effective learning with playing, fun games are presented



⑬ Materials: the necessary materials for learning are added in the appendix

### 3. The Types of teacher textbook use

The researchers mostly classified the teacher textbook use based on the purpose of their use. The table below <Table 4> shows the criteria and types of teacher textbook use.

<Table 4> The types of teacher textbook use

Types	Contents
General Type (Freeman & Porter, 1989)	<ul style="list-style-type: none"> <li>The teacher follows the textbook exactly (Textbook-bound)</li> <li>The teacher changes the textbook on the content based on district objectives (Focus-on-district-objectives)</li> <li>The teacher who teaches only the basic content from the textbook (Focus-on-the-basic)</li> </ul>
	<ul style="list-style-type: none"> <li>The index for explaining the teacher textbook use</li> <li>The level of teacher textbook use</li> </ul>
	<ul style="list-style-type: none"> <li>-Creative use</li> <li>-Refinement of use</li> <li>-Routine use</li> <li>-Mechanical use</li> <li>-Misuse</li> </ul>
The index and level on using textbooks (Fanzhe & Ningzhong, 2009)	<ul style="list-style-type: none"> <li>-Understand and study the textbook</li> <li>-Analyze and integrate the textbook</li> <li>-Apply the textbook</li> <li>-Decision making about the textbook</li> </ul>

<p>The types of textbook use on Mathematics work related to cognitive aspect (Son, Choi, 2008)</p>	<ul style="list-style-type: none"> <li>▪The teacher who gives lessons which requires cognitive thinking at a high levels with the textbook which requires cognitive thinking at a high level</li> <li>▪The teacher who gives lessons which requires cognitive thinking at a low level with the textbook which is requires cognitive thinking at a high level</li> <li>▪The teacher who gives lessons which is requires cognitive thinking at ahigh level with the textbook which is requires cognitive thinking at a low level</li> <li>▪The teacher who gives lessons which is requires cognitive thinking at a low level with the textbook which is requires cognitive thinking at a low level</li> </ul>
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Freeman & Porter (1989) studied the types of teacher textbook use. They distinguished three types of teacher textbook use based on whether a teacher used textbooks as was or used them by making changes. These types can serve as the criteria for this research focusing on the meaning of the effective use of textbooks. Also Fanzhe & Ningzhong(2009) made 4 indexes for analyzing teacher textbook use. They suggest the 7 different criteria making the sub-index, and analyze the 5 levels of using textbooks. The levels range from creative level to misuse level.. In Korea Son & Choi(2008) studied the types of the teacher textbook use. They divided the cognitive aspects of mathematical work by low level and high level. They presented 4 types of teacher textbook use when teachers apply the content in classroom teaching. These types show that the mathematical work possesses important parts of mathematics lessons. However, it is difficult to explain all teacher textbook use with mathematical work only. So, we need to systematically analyze teacher textbook use.

### **III. Design and Methodology**

#### **1. Research design**

The purpose of this research is to analyze Korean teacher textbook use and explore the effective use of textbooks. To accomplish the purpose, first, the researcher sampled and surveyed to formulate conjectures about the teachers' dispositions and the their view of textbook use (Creswell, 2003). Second, the researcher interviewed teachers to get insights about their views. Through the interviews, the researcher sought to find meaningful truths that cannot be discerned from surveys (Patton, 2002).

#### **2. Sample**

In this research, 278 elementary school teachers were sampled using snowball effects. A group interview was conducted with six teachers from the sample to elaborate on specific ideas related to the effective use of textbooks.

The researcher used nonprobability sampling to sample the teachers, specifically snowball sampling. Nonprobability sampling may have problems with representation of the population because it does not include random sampling, but the researcher applied judgemental sampling. In other words the researcher's judgement

was applied to determine the sample represent the population. After the researcher samples a part of the population, the researcher complements the representational problem using snowball effects (Krathwohl, 1998). In this research, the graduate school students of whom the researcher is the advisor were the well known people and their colleagues were asked to respond the survey. The teachers' background is shown in <Table 5>.

<Table 5> The background of the subjects

		Number	Rate(%)
Sex	Male	76	27.3
	Female	201	72.3
	No response	1	0.4
	Total	278	100.0
Teaching experience	Less than 5 years	89	32.0
	5 ~ 9 years	102	36.7
	10 ~ 19 years	51	18.3
	More than 20 years	35	12.6
	No response	1	0.4
	Total	278	100.0
	Teaching place	Seoul	74
Metropolitan city		130	46.8
small and medium-sized city		57	20.5
Town		11	4.0
No response		6	2.2
Total		278	100.0
Academic	Bachelor(Math major)	35	12.6
	Bachelor(Nonmath major)	183	65.8
	Master(Math major)	12	4.3
	Master(Nonmath major)	47	16.9
	Doctor(Math major)	0	0.0
	Doctor(Nonmath major)	1	0.4
	Total	278	100.0

### 3. Data collection and analysis

#### A. Survey composition

To identify elementary school teachers' awareness and use of mathematical textbooks, criteria which was used in research focusing on other subjects including physical education and English, as well as mathematics, were employed for this study. Also the researcher constructed survey items and added several necessary criteria not explicit in the other studies. The survey items are composed with 4 different subscales.

First, items for teachers' demographic background information.

Second, items for identifying teachers' awareness of mathematical textbooks.

Third, items for identifying teachers' use of mathematical textbooks.

Fourth, items for describing teachers' ideas on the meaning of the effective use of mathematical textbooks and specific ideas on the effective use of mathematical textbook.

Survey items were mostly multiple choice and Likert scale. In addition, the effective use of mathematical textbooks followed free descriptive response format. A pretest was conducted with 8 elementary school teachers who are majoring in elementary mathematics. The specific construction of the survey is outlined in the table below <Table, 6>.

<Table 6> Survey area and detailed content

Composition	Domain	Specific content
I . Teachers' demographic background		•Sex, teaching place, teaching experience, teaching grade, Academic background
II . The general awareness about mathematical textbooks	Function	•Awareness about the mathematics textbook function •Awareness about the mathematics workbook function
	The contribution to the mathematics lessons	•Suitability of learning content of the textbooks for accomplishing lesson objectives •Contribution of learning activities in the textbooks for a lesson process •Appropriateness of the amount of learning content in the textbook •Suitability of the textbooks for self-directed learning •Suitability of the textbooks for graded learning •Suitability of the textbooks for developing students' mathematical thinking ability •Suitability of the textbooks for developing students' mathematical communication skills •Suitability of the textbooks for developing students' mathematical problem solving •Suitability of the textbooks for developing students' mathematical creativity
III . The use of mathematical textbooks	Rate of use	•The rate of use for mathematical textbooks and the reason why teachers do not use them •The rate of using items in the textbooks
	Time used	•The time of use for the textbook: before, middle, and after lessons
	Methods of Use	•Ways of using the textbooks •Ways of teaching and learning when using textbooks
	Restructuring the textbook	•Whether they reconstruct the textbooks or not and frequency •Ways of restructuring the textbook •Reasons why they reconstruct the textbook
	use of assisting materials	•Whether or not they use the textbooks and other resources •Kinds of assisting materials used •Reasons why they use the assisting materials
	Referring resource	•Reference of mathematical knowledge for effective use of the textbooks
IV . The awareness about effective use of mathematical textbooks	Meaning of effective use	•Personal ideas about the effective use of textbooks •Whether they use the textbooks effectively
	Ideas about effective use	•Specific ways of effective use of the textbooks when they use, if not, introduction of specific ways for using the textbooks effectively

The data collected through the survey were analyzed by using SPSS and frequency and descriptive analysis were used depending on the item types.

## B. Group Interview

A group interview was conducted with 6 teachers in the researcher's office. The interview lasted two hours. The teachers were asked to describe how they used textbooks effectively. After describing ways of using the textbooks, they were asked to write down their use of textbooks and how they reconstructed the textbooks.

## IV. Results

### 1. The elementary school teachers' awareness about mathematical textbooks in Korea

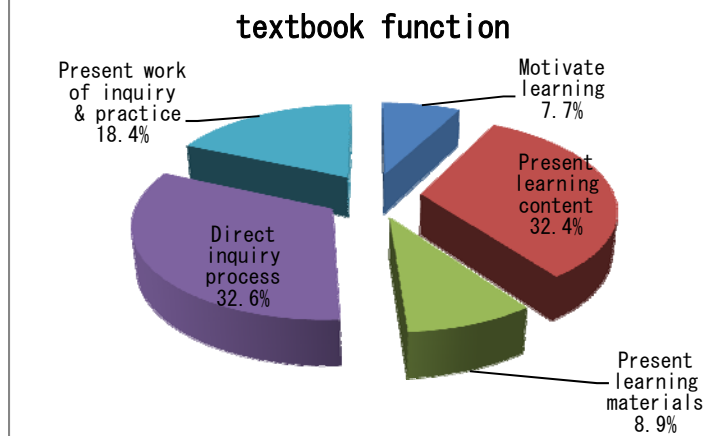
To identify the elementary school teachers' awareness about mathematical textbooks in Korea, the teachers were first given multiple choice items from which they choose the 2 functions for the textbooks from given examples. Second, they were given items to quantify related to how much the textbooks contribute to accomplishing learning objectives that is emphasized in the curriculum, students' self-directed learning and graded learning, and developing students' mathematical thinking, problem solving ability, mathematical creativity.

Five examples were presented about the function of mathematical textbooks, motivating learning, presenting learning content, presenting learning materials, directing inquiry processes, and presenting work of inquiry and practice. 278 teachers choose 2 ;however, 50 teachers chose 1 example making the response number 506. For the important function of the textbooks, the most chosen examples were 'direct inquiry process'(32.6%) and 'present learning content'(32.4%). The next were 'present work of inquiry and practice'(18.4%), 'present learning materials'(8.9%), and 'movitate learning' (7.7%). The response about workbook function had no response and choice of one example was 510. The 'presenting work of inquiry and practice'(51.8%) was the first and the second was 'presenting learning materials'(22.2%). The order of the chosen examples is shown below <Table 7>.

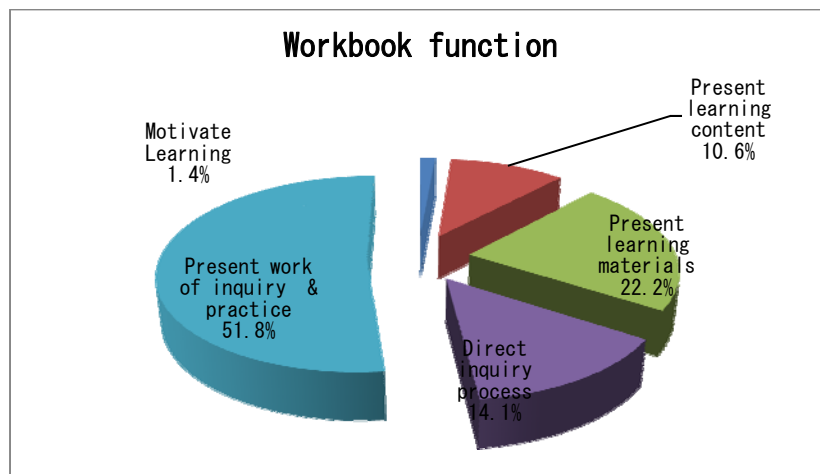
<Table 7> The awareness about mathematical textbooks' function

examples	textbook(N=506)		workbook(N=510)	
	Response number	rate(%)	Response number	rate(%)
Movitate learning	39	7.7	7	1.4
present learning content	164	32.4	54	10.6
present learning materials	45	8.9	113	22.2
direct inquiry process	165	32.6	72	14.1
present work of inquiry and practice	93	18.4	264	51.8

Total	506	100.0	510	100.0
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[Figure 1] The textbook function



[Figure 2] Workbook function

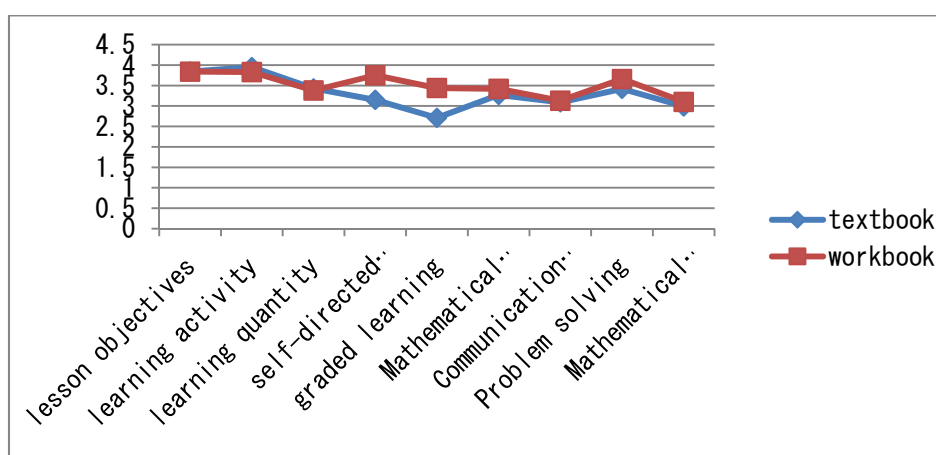
If we compare [Figure 1] and [Figure 2], we can see that the teachers think that ‘motivate learning’, ‘present learning process’, and ‘direct inquiry process’ are more important in the textbook rather than the workbook. They also think that ‘present learning materials’ and ‘present work of inquiry & practice’ are more important in the workbook rather than textbook.

The ratings that the teachers gave (1 to 5 points among 9 examples) related to how much the textbooks contribute in the mathematics lessons is shown below <Table 8>. The rate of contribution, 3 is ‘average’. 4 is ‘contribute more.’ Based on the rate, the teachers have positive aspects on elementary mathematics textbooks because most items’ rated are between 3 and 4. They think that the elementary mathematics textbooks are well matched with the national curriculum

<Table 8> The awareness about the textbooks’ contribution to the mathematics lessons (N=278)

Items	Textbook	Workbook
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	average	SD	Average	SD
The learning content in the textbook is appropriate for accomplishing the classroom lesson objectives.	3.84	.713	3.84	.786
The learning activities in the textbook are helpful to proceed the classroom lessons.	3.95	.776	3.83	.843
The learning quality is suitable for advancing the classroom lessons.	3.43	.898	3.38	.921
The textbook is appropriate for students' self-directed learning.	3.15	.905	3.75	.879
The textbook is appropriate for graded learning.	2.71	.839	3.44	.913
The textbook is appropriate for developing students' mathematical thinking abilities.	3.27	.818	3.42	.845
The textbook is appropriate for increasing students' mathematical communication skills.	3.09	.814	3.13	.846
The textbook is appropriate for developing students' mathematical problem solving.	3.42	.765	3.66	.804
The textbook is appropriate for developing students' mathematical creativity.	2.99	.795	3.10	.798



[Figure 3] The textbooks' contribution on mathematics classroom lessons

The teachers think that lesson objectives are accomplished well when they teach with the textbook (3.84) and the learning activities in the textbook are helpful for advancing the classroom lessons (3.95). Also, they indicated that the workbook is helpful for accomplishing the lesson objectives (3.84), learning activities in the workbook are appropriate (3.83), and the workbook is well composed for students' self-directed learning (3.75). Meanwhile, they graded lowest (2.71) on whether the textbook is appropriate for graded learning while the workbook average was 3.44. From these results, we can see that the teachers gave positive meaning to the workbook rather than the textbook on graded learning. Also, we can confirm that teachers evaluated the higher contribution of the workbook than the textbook and on other items there is no difference between textbook ratings and workbook ratings [see Figure 3]. The more reform oriented the curriculum, the greater the

emphasis on mathematical creativity. The average for the textbook is 2.99 and for the workbook is 3.10 on the question whether the textbooks are composed appropriately for developing mathematical creativity. The teachers gave low points on the appropriateness for developing students' mathematical creativity. From this result, we can infer that teachers need to use the textbook effectively to develop students' mathematical creativity. An analysis of the responses from the item that asked about what effort teachers devote to develop students' mathematical creativity, the data provides specific examples for using textbooks. Many teachers responded that they use mathematics notebooks with the textbooks. Specifically, the teachers use activities that require students to make various problems and write in their mathematical journal or diary. In addition, even though the use of materials are not shown in the textbook, the teachers make an effort to use various teaching materials to develop students' mathematical creativity, to use open-ended questions in classroom teaching, and to ask students to present various problem solving processes and explain their problem solving processes.

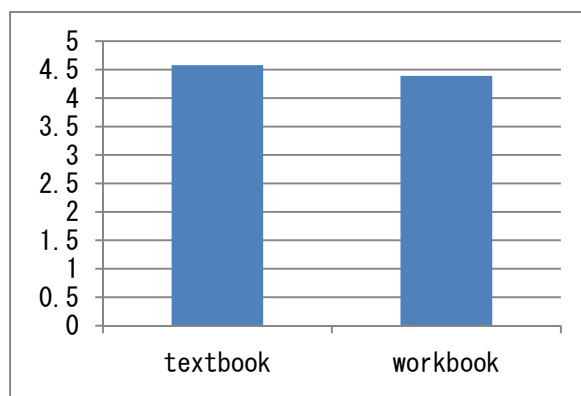
## 2. The elementary school teachers' textbook use in Korea

To understand the teachers' use of mathematical textbooks, the rate of use of mathematical textbooks, the rate of use of structural items, the time of use and the period in lessons, the teaching and learning methods in using the textbooks, reconstructing, and the use of extra teaching materials were explored.

The rate of use was evaluated in 1~5. First, the average of the textbook use is 4.58 and the average of the workbook use is 4.39. Both textbook and workbook use average is close to 5 points. These results mean that the teachers use textbook and workbook very often in mathematics teaching <table 9>, [Figure 4].

<Table 9> The use rate of mathematical textbooks(N=278)

Item	Average	SD
Textbook	4.58	.619
Workbook	4.39	.718



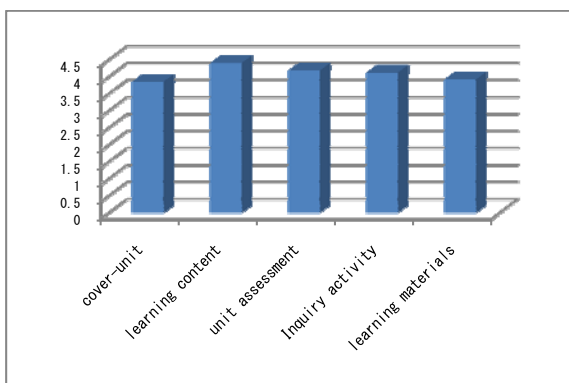
[Figure 4] The use rate of the textbooks



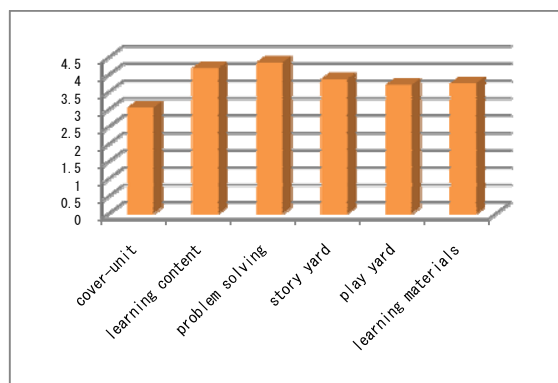
To understand specific use of the textbooks, we first examined the teachers rate of use of each structural item <Table 10>. Because each structural item of the unit was based on 2007 reform curriculum, 114 teachers taught 1~4 grade students on 2010. Fifth and sixth grade did not adopted the 2007 reform curriculum yet. All the rate of use items were more than 3 points. So, we conclude that the elementary teachers evenly use items presented in the textbooks. In the textbook, the highest rate of use was ‘learning content for lessons’(4.40) followed by the ‘unit assessment’(4.18) and Inquiry activity(4.12). In the workbook, the highest rate of use was ‘problem solving’(4.36), followed by the ‘learning content for lessons’(4.19). Among the whole constructed set of items the lowest rate of use was the ‘unit cover’ in the workbook. The reason why they do not frequently use the ‘unit cover’ in the workbook is that they more often rely on the ‘unit cover’ of the textbook.

<Table 10> The use of structural items of mathematical textbooks(N=114)

	Item	Average	SD
Textbook	Cover-unit	3.85	1.115
	Learning content for lessons	4.40	.675
	Unit assessment	4.18	.937
	Inquiry activity	4.12	.777
	Learning materials	3.92	.913
Workbook	Cover-unit	3.06	1.254
	Learning content for lessons	4.19	.872
	Problem solving	4.36	.802
	Story yard	3.88	.998
	Play yard	3.71	1.091
	Learning material	3.76	1.011



[Figure 5] The textbook use rate of items



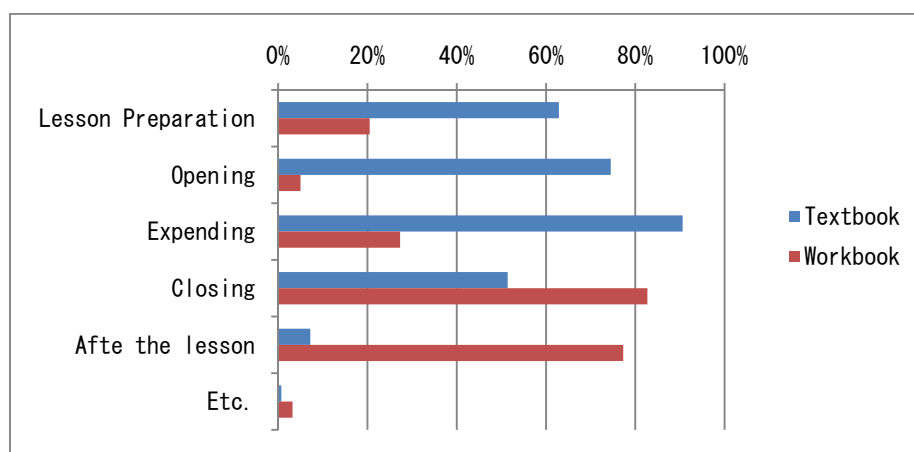
[Figure 6] The workbook use rate of items

For the time period of use of mathematical textbooks in classroom teaching, the responses of ‘lesson preparation’(62.9%) and ‘middle of the lessons’ were the most frequent. In the middle of the lesson, step by step

activities are done for accomplishing the lesson objectives in the expanding stage. The teachers use the textbook most (90.6%) in the expanding stage of the ‘middle of the lessons.’ Also, 74.5% teachers use the textbook for the purpose of identifying the learning objectives and presenting the problem situation at the opening stage of each lesson. In case of the workbook, 82.7% teachers use the workbook at closing stage and 77.3% teachers use it after the lesson. This means that the teachers use the workbook after finishing the lesson content with the textbook, or after finishing the lesson they give as solving the workbook problems as homework. Other responses included that they use the textbooks for teaching low achievement students individually, use the workbook for tests, and in the morning sessions before the lesson.

<Table 11> The using time of the textbooks(N=278)

Items		Lesson	Middle of the lesson			After the	Etc.
		Preparation	Opening	Expanding	Closing	lesson	
Textbook	Response	175	207	252	143	20	2
	(%)	(62.9)	(74.5)	(90.6)	(51.4)	(7.2)	(0.7)
Workbook	Response	57	14	76	230	215	9
	(%)	(20.5)	(5.0)	(27.3)	(82.7)	(77.3)	(3.2)



[Figure 7] The using time of the textbooks

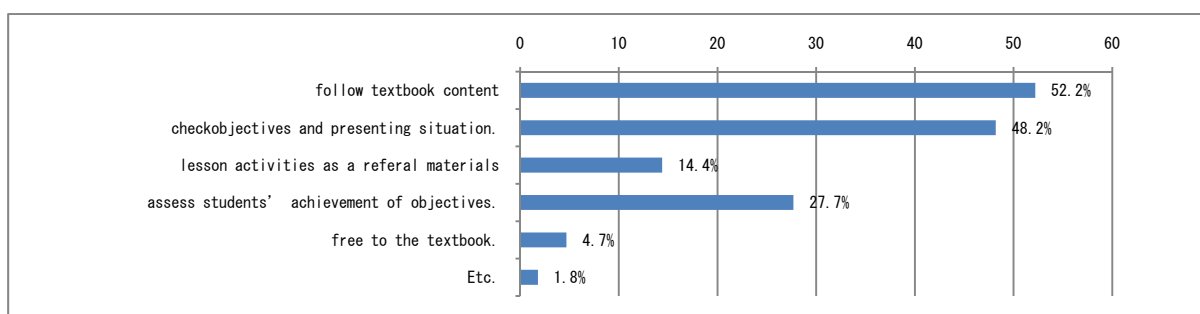
From <Table 11>and [Figure 7] we see that more teachers use the textbook for lesson preparation and the opening and expanding stages than the workbook. Toward the closing stage, the greater the use of the workbook. After the lesson, the workbook use was much higher than the textbook.

For the ways of using the mathematical textbooks, 52.2% of the teachers responded that they teach all the students following the textbook content when they use the textbook. 48.2% of the teachers responded that they use the textbook for identifying the learning objectives and presenting the problem situation. From the results we observe that the teachers were guided for identifying the learning objectives after the lessons by the textbook and used the textbooks for presenting the problem situation in introducing the learning content. 80.2% of the teachers use the workbook for supplementary teaching materials. From this result we can imply that many

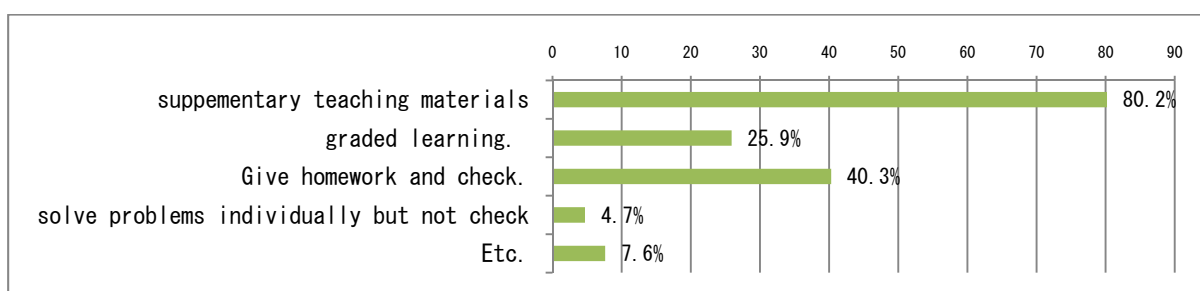
teachers think that the textbook is more fundamental for teaching materials than the workbook and they use the workbook as a supplementary tool. Besides the role of supplementary teaching materials, 40.3% of the teachers responded that they give the workbook for the homework and check. Because the content of the workbook is too much for completing during classroom teaching, the teachers give solving workbook problems for homework. Also 25.9% of the teachers use the workbook for checking by level based learning and teaching <Table 12>.

<Table 12> The way of using the mathematical textbooks(N=278)

	Item	Response number	Rate(%)
Textbook	Teach all the students following the textbook content.	145	52.2
	Use the textbook for checking learning objectives and presenting the problem situation.	134	48.2
	Use the lesson activities as referral materials.	40	14.4
	Use the textbook for assessing students' achievement of learning objectives.	77	27.7
	Implement various lessons being free from the textbook.	13	4.7
	Etc.	5	1.8
Workbook	Use as a supplementary teaching materials for the textbook.	223	80.2
	Use for the graded learning.	72	25.9
	Give homework and check.	112	40.3
	Make students solve the problems individually but not check.	13	4.7
	Etc.	21	7.6



[Figure 8] The ways of using the textbook

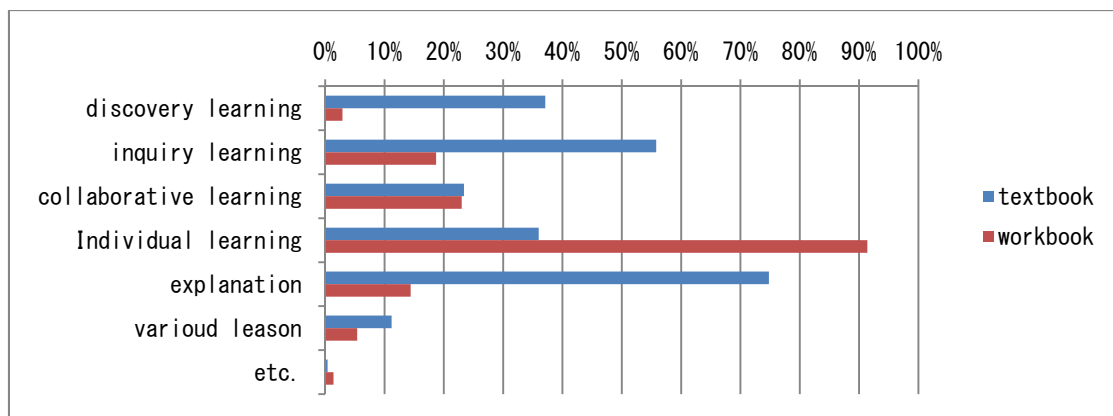


[Figure 9] The ways of using the workbook

For the main way of teaching and learning, 74.8% of the teachers use the explanation when they use the textbook and 91.4% of the teachers use f individual learning when they use the workbook. Compared to the workbook use, teachers use various teaching methods, discovery learning, inquiry learning, collaborative learning, when they use the textbook <Table 13 >.

<Table 13> Teaching and learning method for using mathematical textbooks(N=278)

Item		discovery learning	inquiry learning	collaborative learning	Individual Learning	Explanation	Free from the textbooks	Etc.
Textbook	Response (%)	103 (37.1)	155 (55.8)	65 (23.4)	100 (36.0)	208 (74.8)	31 (11.2)	1 (0.4)
Workbook	Response (%)	8 (2.9)	52 (18.7)	64 (23.0)	254 (91.4)	40 (14.4)	15 (5.4)	4 (1.4)



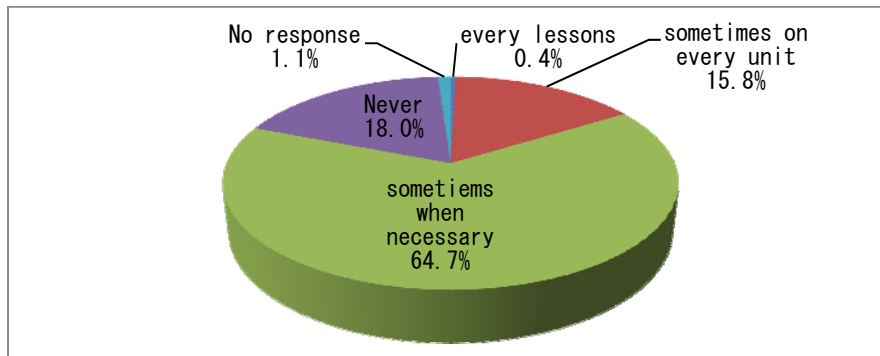
[Figure 10] Teaching and learning method when they use the textooks

In the items that asked about textbook reconstruction, 18.0% of the teachers use the textbook without restructuring the textbook, except 1.1% of teachers who did not respond while the rest of the teachers use the textbook with reconstruction depending on the situation. For the frequency of the textbook reconstruction, 64.7% of the teachers do sometimes, when it is necessary, and 15.8% of teachers do sometimes on every unit while 0.4% of the teachers do with every lesson <Table 14>.

<Table 14> Textbook reconstruct and frequency(N=278)

Item	Response	Rate(%)
Reconstruction on every lessons .	1	0.4
Reconstruction sometimes on every unit.	44	15.8
Reconstruction sometimes when it is necessary.	180	64.7
Never reconstruct and follow the textbook content and order.	50	18.0
No response	3	1.1

Total	278	100.0
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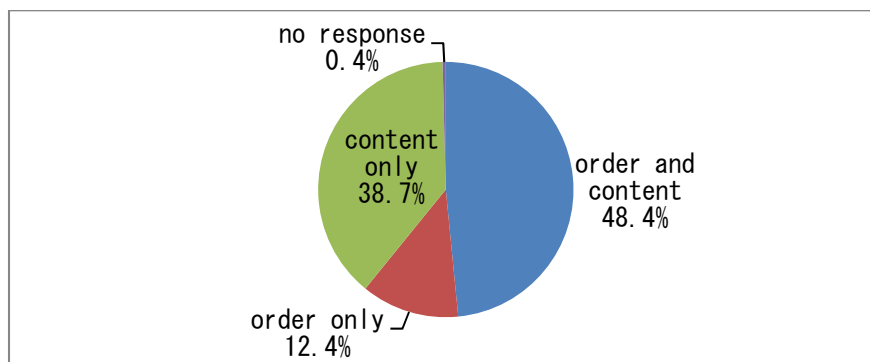


[Figure 11] Textbook reconstruction and frequency(N=278)

225 teachers who restructure the textbook were asked about the methods of reconstruction. 48.4% of the teachers reconstruct the textbook on content and order of the content, 38.7% reconstruct the content only and 12.4% reconstruct the order only. These findings reflect teachers' thought that the textbook's content order of national curriculum is systemized considering the mathematical system and students' developmental stage <Table 15>.

<Table 15> The way of textbook reconstruct(N=225)

Item	Response	Rate(%)
Reconstruct both textbook order and content	109	48.4
Reconstruct textbook order only	28	12.4
Reconstruct textbook content only	87	38.7
No response	1	0.4
Total	225	100.0

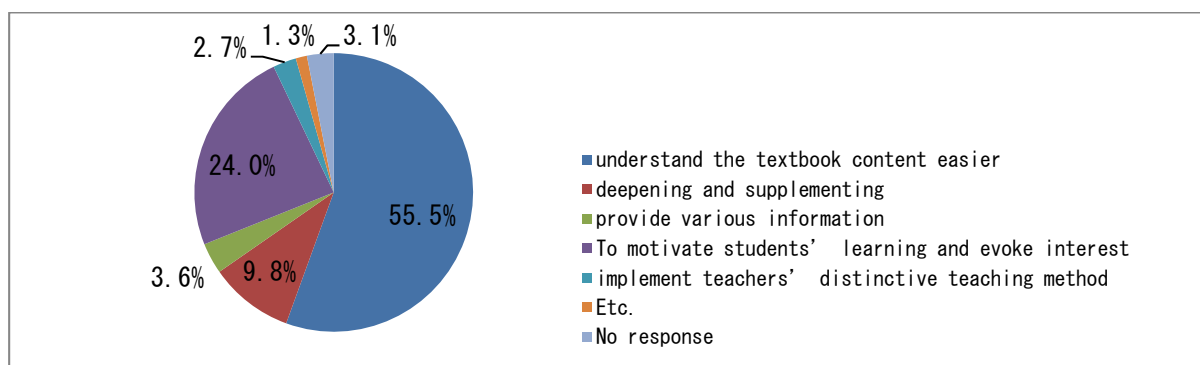


[Figure 12] The way of textbook reconstruct(N=225)

55.6% of the teachers responded that they restructure the textbook for making students understand easily;24.0% responded for motivating students' learning and interest; and 9.8% responded for deepening and supplementing the textbook content <Table 16>.

<Table 16> Textbook restructuring reason(N=225)

Item	Response	Rate(%)
To understand the textbook content easier	125	55.6
To deepen and supplement the textbook content	22	9.8
To provide various information to students	8	3.6
To motivate students' learning and evoke interest	54	24.0
To implement teachers' distinctive teaching method	6	2.7
Etc.	3	1.3
No response	7	3.1
Total	225	100.0

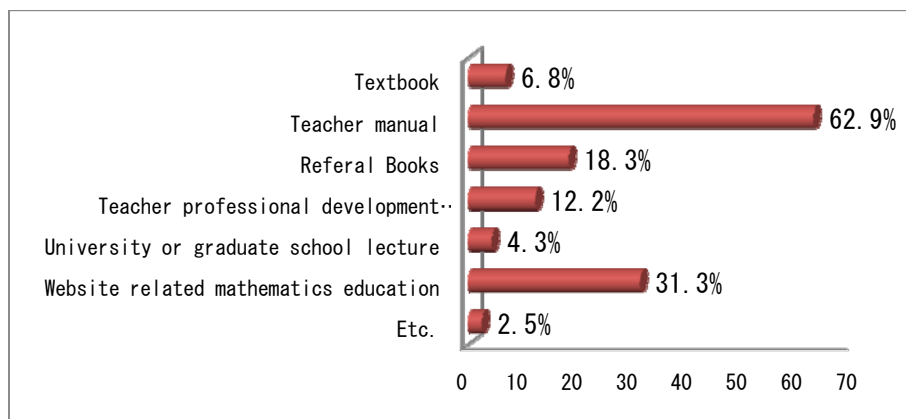


[Figure 13] Textbook restructuring reason(N=225)

The teachers were asked where they get the mathematical knowledge when they use the mathematical textbooks. The teachers get reported that they get most of the material from the teacher's manual (62.9%), websites related with mathematics education (31.3%), reference books (18.3%), and teacher professional development programs (12.2%) <Table 17>. Other ways include the teacher's community and colleagues.

<Table 17> The sources of mathematical knowledge for effective use of the textbook (N=278)

Item	Response	Rate(%)
Textbook	19	6.8
Teacher manual	175	62.9
Reference Books	51	18.3
Teacher professional development program	34	12.2
University or graduate school lecture	12	4.3
Website related mathematics education	87	31.3
Etc.	7	2.5



[Figure 14] The sources of mathematical knowledge for effective use of the textbook(N=278)

### 3. The ways for effective use of the mathematical textbooks

The teachers were asked to describe freely their opinions on the meaning of effective textbook use. Table 18 summarizes their thinking.

<Table 18> The teachers' opinions about the meaning of effective textbook use (N=162)

Item	Response (%)	Examples of the representative response
Textbook centered teaching but teacher need to reconstruct the textbook	46 (28.4)	<ul style="list-style-type: none"> <li>Depends on the students' level of understanding and attention, both the order and content should be reconstructed but students need to learn all the textbook content.</li> </ul>
Use as reference resources for achieving learning goals	24 (14.8)	<ul style="list-style-type: none"> <li>Have to use to assist for accomplishing the learning goals ( does not need to teach all the textbook content</li> </ul>
Use as a fundamental tool through the whole lesson	21 (13.0)	<ul style="list-style-type: none"> <li>Because many researchers developed it for teaching and learning over a long time, we should use it enthusiastically through the whole classroom lesson to accomplish the national curriculum goals.</li> </ul>
Extract core elements and use it without relying on the textbook	13 (8.0)	<ul style="list-style-type: none"> <li>Considering classroom environment and students' learning level, extract least element, reconstruct and use it.</li> <li>Do not rely on the textbook content entirely and use it in extracting mathematical element in various situations.</li> </ul>
Teach after identifying the content and learning process	13 (8.0)	<ul style="list-style-type: none"> <li>Mainly use for getting lesson process</li> <li>Referring to teacher manual which explains the textbook, use it after identifying the textbook authors' intention and the best way of teaching method matching with the intention</li> </ul>
Use it to understand learning questions and basic concepts and principles	13 (8.0)	<ul style="list-style-type: none"> <li>Use it as teaching and learning materials for students to understand mathematical concepts and principles and problem solving</li> <li>Use it for identifying learning questions and fundamental concepts and principles</li> </ul>

Use it for presenting the inquiry process	8 (4.9)	▪ Use it for evoking interest and presentation of resources for inquiry process ▪ Use it for group or individual work after presenting mathematical situation
Summarizing and assessing lesson contents	5 (3.1)	▪ It should be helpful for checking what students understand and assessment. ▪ Use it for summarizing the lesson content and inquiry process
Use it for individual learning	5 (3.1)	▪ Use it for individual learning, adjusting students learning level
Use it for student self-learning	4 (2.5)	▪ Use it for self-directed learning ▪ Guide students to use it for their self-learning
Etc.	10 (6.2)	▪ Use it to develop the thinking process of problem solving ▪ One of the resources for mathematical problem situation
Total	162 (100.0)	

<Table 19> The teachers' effective use of textbook (N=278)

Item	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response	Total
Response	30	122	117	4	0	5	278
(%)	(10.8)	(43.9)	(42.1)	(1.4)	(0.0)	(1.8)	(100.0)

The teachers were asked to describe the specific ways of using textbooks effectively. Many teachers described their own way of effective use of textbooks. 8 of the teachers described the following methods. First, present the problem similar to or equal to the 'everyday life problem' in the textbook. Second, make students solve it by exploring themselves. Third, students solve the problem on their notebook and know various solving strategies. Fourth, solve the practice problems from the textbook. Fifth, summarize the final content of the textbook. Sixth, solve more difficult problems from the textbook. Seventh, solve the problems in the workbook. These teachers reported use of the textbook and workbook very often in the classroom teaching.

For using the textbook effectively, teachers asked to offer some recommendations.. The construction of the textbook and the textbook authors' intension were explained to the teachers. So, the teachers need to have professional development programs for the textbook use. Also before using the textbook, teachers need to study teaching and learning strategies and tips for the teaching process. The textbook needs to have activities that can be done by alone as well as collaborative groups

#### 4. Two teachers' opinion about the effective use of mathematical textbooks

Among the 6 interviewers two teacher's opinions about the effective use of mathematical textbooks is described. The first teacher is Yoon. She is a graduate student who teaches 4th graders. She expanded on textbook use. The second teacher is Han. She is teaching 5<sup>th</sup> graders. She expanded on workbook use.

##### A. The teacher Yoon's opinion about the textbook use



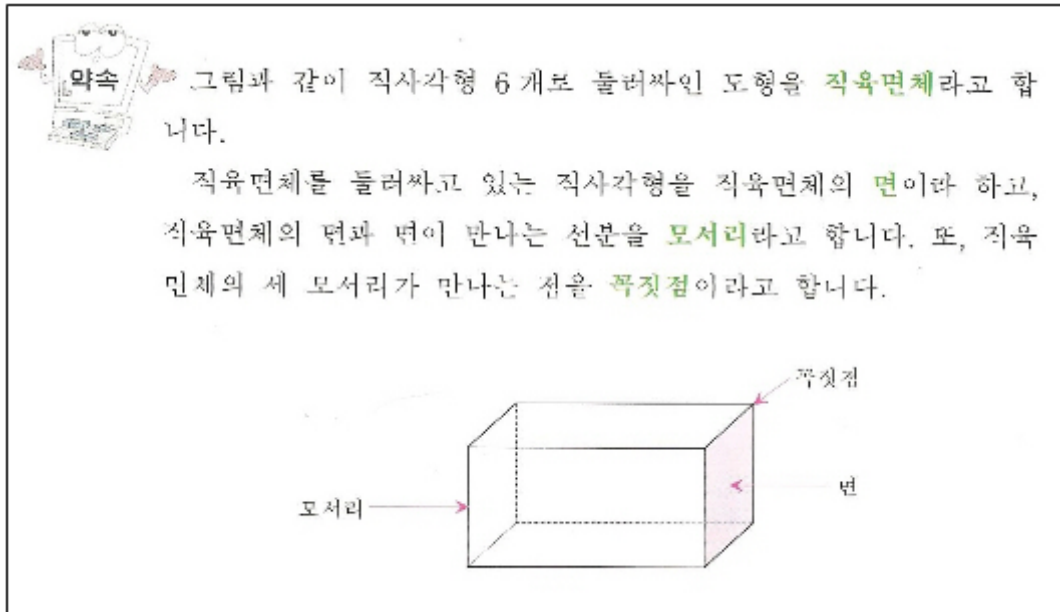
Yoon thinks that the textbook is immediately available in the class and the material implements the curriculum concretely. But, the textbook is one of the teaching materials, thus, a teacher can use other materials instead of textbook to implement the curriculum at any time. Most of the in-service teachers may try to reconstruct the textbook in order to prepare the open classes or to achieve specific purposes such as conducting some research. Also, some teachers reconstruct the textbook with goals such as reaching the learning objectives and understanding of students. Yoon also reconstructs the textbook for the above three reasons. But the biggest challenge to reconstructing the textbook is that the teachers should reconstruct the textbook including the original contents of textbooks when beginning a new idea and trying to reconstruct according to this idea. If a teacher adds other activities in the lesson, he can't teach all of the contents in the textbook on time. Because a teacher should teach all of the content in the textbook to be recognized as the faithful teacher, most of the teachers will take time to make up missed learning content.

#### **B. The teacher Yoon's case of mathematics textbook use**

'Doing promise' in the mathematics textbook is to define mathematical terms and symbols learned through the activities. This is equally used in the learning and teaching situation, so the students are expected to understand the content of 'Doing promise' surely. This helps teachers prepare for their classes as well as helps students understand the mathematical concepts.

The teacher Yoon tends to make use of 'Doing promise' more frequently when she teaches the content of geometry strand. Although she is fully aware of the mathematical content knowledge required in the class, she has the students confirm and use the mathematical concepts through the part 'Defining' in textbook. Teachers should convey a more accurate information to the students.

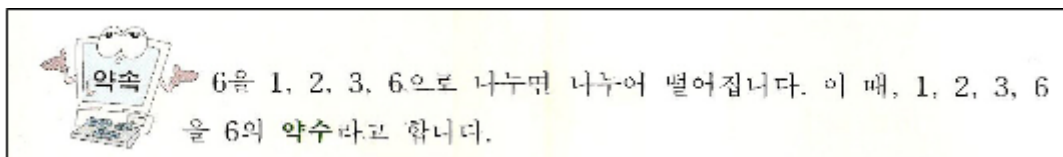
For example, Yoon has a good knowledge of mathematical terms such as rectangular prism, faces, edges and vertexes that are required in the unit 'Rectangular prisms (5-A)'. But, she makes full use of the part 'Doing promise' in textbook, because as the teacher, she feels she should use the accurate mathematical terms and definitions.



[Figure 15] The part of the textbook on the rectangular Prism

As shown above, ‘Doing promise’ covers the definitions of rectangular prism, faces, edges and vertexes which the students are required to know. This part aims to help the students understand mathematical concepts. In addition, the teachers can confirm the appropriate definitions for the 5th graders through ‘Doing promise’.

Yoon often uses the part ‘Doing promise’ in the numbers and operations strand. The concept of ‘divisor’ is introduced first to the 5th graders. To them, the divisor means the number that can divide the dividend (the number being divided) exactly as the opposite concept of the multiple. The divisor is typically defined within the range of integers and it also can be generalized to define the domain. It can be introduced as shown in the part of textbook (‘Doing promise’) below:



[Figure 16] ‘Doing promise’ of the divisor in the textbook

So, the part of ‘Doing promise’ in the textbook can be used as guidelines to confirm the definition of mathematical concepts when the teachers prepare for their classes.

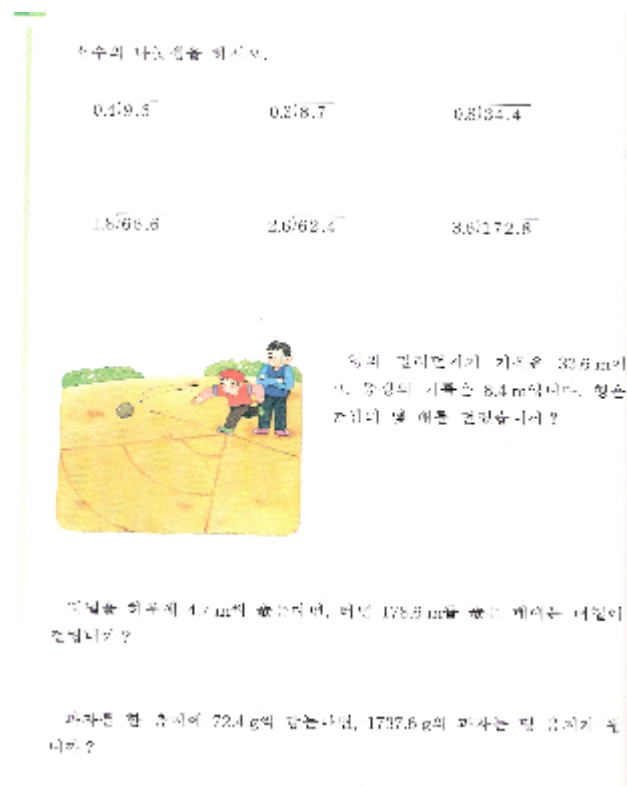
### C. Han’s application methods of the mathematics Workbook

At most of schools, the mathematics workbook is given for homework or used as learning materials which the students solve by themselves and then the teacher gives the answers in class. But if the teachers use the mathematics workbook as below, they can make the math classes more efficient and useful.

### 1) Teaching and Learning Each Other and Developing the Ability (TLEODA)

The students have difficulties in solving the mathematics workbook and are bored with it. The teachers know that personal teaching is the most effective but it is impractical. Therefore, the teachers let the students solve the mathematics workbook formally and just give the answers sometimes. But the teachers can use the mathematics workbook more efficiently if they use the method of **TLEODA**.

**TLEODA** is literally teaching and learning each other and developing the ability to think mathematically. If the students share their solutions and discuss them with other group members after solving the mathematics workbook personally, they can communicate mathematically, present their problem-solving methods and use meta-recognition to organize their thought processes. It helps that mathematical low achievers overcome difficulties in learning by discussing with other learners and receiving their assistance. If there are the problems which are not solved by themselves, the students will naturally ask their teacher about these problems. And the students can readily make sense of the teacher's explanation about the problems, because they thought about them many times.



[Figure 17] Rounding off the quotient of the workbook

Figure 17 shows the part of the workbook about 『Rounding off the quotient』 in the unit 「6-B 3. Division of decimals」. In this part, there are not only the simple operation problems but also the word problems that many students have difficulties in solving. The word problems offer more opportunities for the discussion about division's principle than the simple operation problems. These problems also enhance the

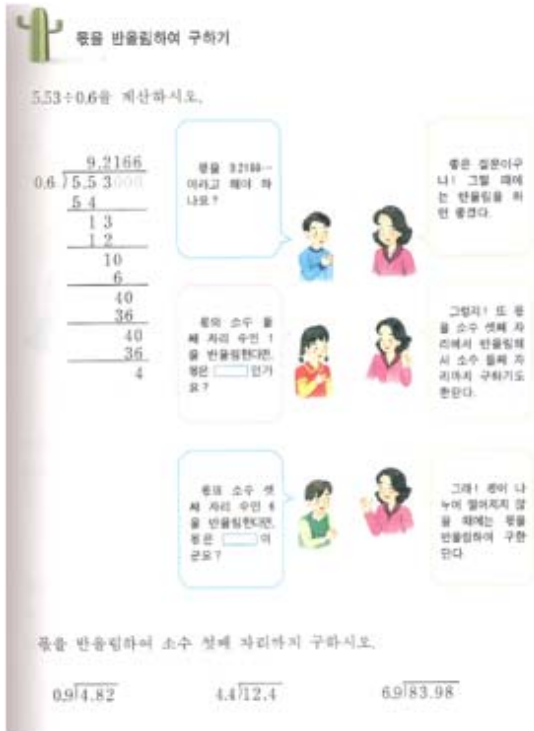
mathematical thinking ability and understanding of the students. It is important that the teachers make students verify their problem-solving processes by showing the right processes after the discussion among the students.

When Han actually used the mathematics workbook in the manner of **TLEODA**, the number of mathematical low achievers dropped off, the students' academic ability improved during teaching and learning within groups, the students became more familiar with others through the communication and the students' social consideration for others and feeling of mutual trust were formed.

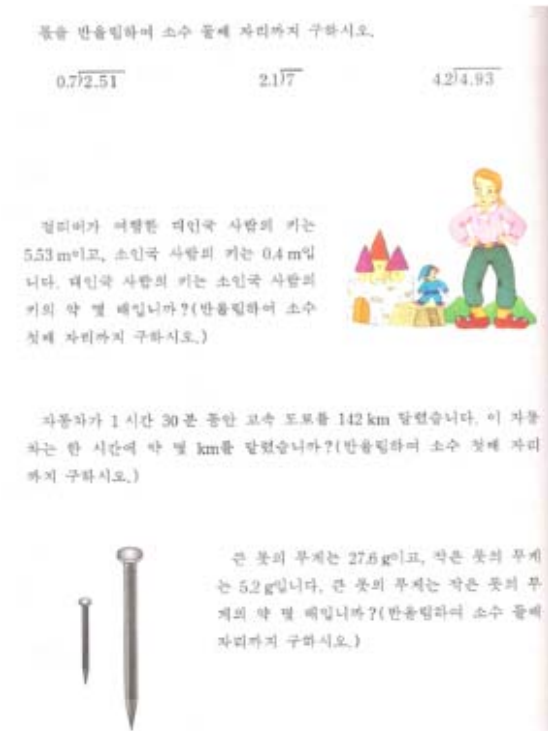
## **2) The workbook use for graded learning**

Each of lessons in mathematics workbooks begins with the information about the procedures for operations, followed by basic problems for the principle and a lot of exercises. The mathematical low achievers are apt to hate to study mathematics when they became tired of solving a lot of problems. Thus, teacher Han provided her students with opportunities for graded learning after the students performed the activities of 「Practice」 in the mathematics workbook. For example, the students lacking in understanding about the essential elements of learning, solved the problems such as [Figure 18], on the contrary, students having sufficient understanding solved the problems such as [Figure 19] in the workbook. By doing this, the teachers do not need to prepare other teaching materials for graded learning. In addition, the students make effective use of their time during the class through the appropriate learning for their own level.

Because graded (level-based) learning is performed in every single class, not after finishing all classes of a unit, unnecessary loss of time can be avoided. The teachers should not expect all of their students to solve all of the problems in the mathematics workbook. To use the mathematics workbook effectively, teachers should have their students solve the appropriate problems for own level.



[Figure 18] Division problem on the textbook



[Figure 19] Word problem for division

### 3) The workbook use for performance assessment

The questions for review are given in each unit of a mathematics workbook. This part consists of the questions to assess whether the students know the essential elements of learning or not. The teachers can make up extra questions for performance assessment. To assess students' level of attainment, the teachers also can use the questions for review in the mathematics workbook. After solving the questions for review, the students can study 『Learning again (supplementary learning)』 or 『Learning more (enriched learning)』 depending on their personal level. So, the students can do the level-based learning every unit by using the mathematics workbook. At the beginning of the school year, the teacher Han distributed a sheet like the <Table 20> to her students. After the students finish solving the questions for review, they counted the number of correct answers, and then decided what to study next for themselves.

<Table 20> The check list for unit assessment of mathematics workbook(6-7)

Sequence			1. Fractions and decimals	2. Prisms and pyramids	3. The range of numbers	4. Building blocks	5. Surface area and volume	6. Ratio and proportion	7. Proportional expression	8. Proportion graph	9. Finding out problem-solving methods
1	Review	Number of questions	22	9	13	9	10	21	15	8	4
1	Review	pass or fail	(18)	(6)	(11)	(6)	(6)	(15)	(11)	(6)	(3)
1	Review	Number of correct answers									
2	pass or fail	pass									

2	pass or fail	again									
3	Learning again (supplementary learning)	Number of questions	18	9	3	9	12	18	9	10	4
3	Learning again (supplementary learning)	Number of correct answers									
4	Learning more (enriched learning)	Number of questions	5	4	8	6	12	11	8	8	3
4	Learning more (enriched learning)	Number of correct answers									

“The unit assessment of mathematics workbook should be performed within class. So, do not solve the questions in advance. Everybody can be a master of mathematics. Way to go!”

Because the mathematics workbook includes the unit assessment and promotes success at learning as well as the level-based learning of each class, the effective use of mathematics workbook helps make math classes very meaningful.

## V. Conclusion

From the results, there are several conclusions that can be formulated as well as some implications. First, the teachers think that the textbook functions to direct inquiry processes and present learning content and the workbook functions to present work of inquiry and practice, and to present learning materials. So they think the textbook and the workbook have different functions for classroom lessons. So when the authors make the textbook and workbook, they need to consider the teachers’ awareness. They should make the textbook more clearly on directing inquiry processes and learning content. Also they need to focus on present work of inquiry and practice in the workbook.

The teachers rated high the contribution of the mathematical textbooks for teaching mathematics. They thought that the textbooks are well matched with the Korean national curriculum. So, we can infer that the textbooks are well made for reflecting the national curriculum and can help teachers for teaching mathematics. However, the teachers do not think that the textbooks encourage students to enhance mathematical creativity. The mathematical creativity is getting emphasized in this society, but the mathematics textbooks do not well support mathematical creativity enhancement. The textbook authors should make efforts to reflect mathematical creativity in the textbooks.

Most of the teachers use the textbook and workbook very often in classroom teaching. However, the teachers use the textbook more on the lesson preparation and opening and expanding stages in the lesson and use the workbook more on closing the lesson and after the lesson. So the time of use is different. The textbook should be focused more on preparation and opening parts. The cover-unit on the textbook should include attractive pictures or illuminations. The workbook is used for homework, so it should be constructed by

considering self-directed learning and graded (level-based) learning. This means that students should be able to solve the problems in it and should be able to check their solutions by themselves.

Many teachers teach all students by simply following the textbook content. The teachers need to reconstruct the textbook to teach and to do so they need to take professional development programs focused on mathematics textbook use. Most teachers do not know the textbook authors' intention. So there is a gap between teachers' teaching and the textbook author's intention. This means that the teachers cannot use the textbook effectively. Eventhough many teachers reconstruct the textbook when it is necessary, because they do not know the textbook authors' intention, they might simply reconstruct the order and content of the textbook. When the textbooks are made, the intension of the textbooks should be clear to the teachers and workshops should be provided.

From the two teachers Yoon and Han, the core concept of the textbooks should be identified first to make sure that the students understand the core concepts and practice to keep the concept in mind. Because many problems cannot be put in the textbook, the teachers use the workbook effectively. The workbook can be used as for teaching and learning and developing abilities for graded (level-based) learning, and for performance assessment. The workbook should be able to support all these ways of strategy use.

This research could not focus on specific ways of using the textbooks in the classroom teaching practically. Further research is necessary to study teachers' use of textbook in classroom teaching.

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